The data presented in this section are for an EIRP of 1 MW. Some of the DTV channels have maximum power allocations of 1.64 MW EIRP. The E-fields presented here can be transformed to a 1.64 MW EIRP by multiplying the results in all the figures by a factor of 1.3, resulting in even higher E-field strengths than those presented here.

## 4. COMPARISON OF MEASURED AND PREDICTED E-FIELD STRENGTHS

The data in the last section show measured E-field strengths for the two proposed DTV tower sites at 1 MW EIRP. The data were collected for a transmitter height of 3.66 m (12.0 ft) on the cliff edge of Eldorado Mountain (not the proposed 116 m (380 ft) height), and for a transmitter height of 8.2 m (27 ft) at Squaw Mountain (not the proposed 60.96 m (200 ft) height). In order to verify any calculated E-field strengths at the proposed tower locations and heights, comparisons to measured data for the lower antenna heights are needed. In this section, calculated E-fields obtained from the ITM (Longley-Rice model) are compared to the measured data in the above section.

Using a 1 MW EIRP and the same transmitter and receiver antenna heights as were used in the measurements, the E-field strengths for a transmitter located on Eldorado Mountain were calculated using the ITM. Contour plots of E-field strengths for the Boulder–Denver area at 533 MHz, for both a horizontally and vertically polarized transmitting antenna, are shown in figures 49 and 50, respectively. Figures 51 and 52 show the contour plots of E-field strengths for the Boulder–Denver area at 772 MHz for both a horizontally and vertically polarized transmitting antenna, respectively. The different colors on these contour plots indicate different E-field strengths.

Using the results shown in figures 49 through 52, specific locations can be directly compared to the routes that the measurement vehicle drove to collect the data in the previous section. Figure 53 shows the calculated E-field strengths for the 28$^{th}$ Street route in Boulder for 533 MHz. These results were calculated using receiver latitudes/longitudes obtained from the GPS data set collected during the measurements. Upon comparing the measured (see figure 13) and predicted (or modeled) E-field strengths, excellent agreement is demonstrated. Both the measured and predicted field strengths are about 0.7 V/m on the LOS portion of the route (before the Highway 36 intersection). It is also seen that both the measured and the predicted field strengths are about 0.02 V/m on the non-LOS path portion of the route (Highway 36 to the Table Mountain NRQZ).

Notice, however, that the measured data have much more variability than the predicted field strengths. As mentioned above, the variability in the measured data is due to the vehicle's motion and the motion of the local objects relative to the measurement vehicle, as well as the fact that the measured data contain three-dimensional multipath effects. Reflections reaching the receiver from all directions are indicative of a true three-dimensional multipath environment. Keep in mind that the predicted E-field strengths do not have local scatterers (i.e., buildings, cars, people, etc.) in the model. Only the terrain profile is taken into account. Also, the ITM uses only profile data on the bearing from the transmitter to the receiver location, referred to as the great circle path. Thus, multipath due to terrain features that are not in the path from the transmitter and the receiver will not be modeled (i.e., three-dimensional multipath effects are not modeled). With this noted, this comparison shows that the ITM predictions correlate very well to the measured data for both the LOS and non-LOS portions of this route.

Figure 54 shows the calculated E-field strengths for the Broadway route in Boulder. Upon comparing the measured E-field strengths (see figure 14) and modeled results, excellent agreement is again demonstrated. Both the measured and predicted field strengths are about 0.2 V/m near the Table Mountain NRQZ. In the north Boulder part of the route, both the measured and predicted field strengths are about 0.02 V/m. Both results show that field strengths increase as the measurement vehicle climbed out of the shadowed region south of Arapahoe Avenue. Both results also show field strengths of 1 V/m and higher on Highway 93.

Figure 55 shows the calculated E-field strengths for the McCaslin loop in the Boulder area. Upon comparing the measured (see figures 15 and 16) and modeled results, excellent agreement is again demonstrated. Both the measured and predicted field strengths are about 1 V/m and higher for the Highway 93 portion of the route. Also notice that both the measured and predicted results show dips in the field strengths ranging from 0.01 V/m to 0.1 V/m for some of the non-LOS locations. Notice that both the measured and predicted results show the same behavior in the field strengths as the measurement vehicle drove to and from the top of the NCAR site, with the field strengths at the top of NCAR reaching values of 1 V/m. The observed dips in the field strengths seen going to and coming from the top of NCAR are caused by shadowing (non-LOS path) of Eldorado Mountain by Shanahan Hill (also called Shanahan Ridge) on this portion of the route.

Figure 56 shows the calculated E-field strengths for the Table Mountain NRQZ. Upon comparing the measured (see figure 12) and modeled results, excellent agreement is demonstrated. Both the measured and predicted results show field strengths of about 0.2 V/m. Most of the locations at the Table Mountain NRQZ have a LOS path to the Eldorado transmitter, which results in the relatively small variations in the measured field strengths and in the almost constant value of the modeled data. The dips seen in both results correspond to one location at the Table Mountain NRQZ where a non-LOS path is present. Both the measured and modeled field strengths for a transmitter on Eldorado Mountain show that all locations on the Table Mountain NRQZ exceed the FCC regulatory limits given in table 2.

Figure 57 shows the calculated E-field strengths for the DOC Laboratories. Upon comparing the measured (see figure 11) and modeled results, excellent agreement is demonstrated. E-field strengths between 0.5 V/m and 1 V/m are observed. The roads on this site are surrounded by buildings. This is reflected in the measured data and is highlighted in figure 11. The decrease in field strengths seen in the measured data due to building blockage of the signal is not apparent in the modeled data since the ITM prediction model does not take buildings into account in the calculations. There are a few locations on the site where non-LOS paths are present due to shadowing caused by

Shanahan Hill and Table Mesa. At the shadowed location (or non-LOS location) both the measured and modeled results give the same field strength of about 0.05 V/m. Both these results show that the outside field strengths at the DOC Laboratories will be close to 0.5 V/m to 1 V/m, which can possibly jeopardize the sensitive measurements that are performed on the site, see Section 8.

The Squaw Mountain transmitter location was analyzed next. Using a 1 MW EIRP with the same transmitter and receiver antenna heights used in the measurements, the E-field strengths for a transmitter located on Squaw Mountain were calculated. Contour plots of E-field strengths for the Boulder–Denver area for 533 MHz for both a horizontally and vertically polarized transmitting antenna are shown in figures 58 and 59, respectively. Figures 60 and 61 show the contour plots of E-field strengths for the Boulder–Denver area for 772 MHz for both a horizontally and vertically polarized transmitting antenna, respectively. Once again the different colors correspond to different E-field strengths.

Figure 62 shows the calculated E-field strengths for the Table Mountain NRQZ for the transmitter located at Squaw Mountain. Upon comparing the measured E-field strengths (see figure 32) and modeled results, good agreement is demonstrated. Both the measured and predicted results show field strengths of about 1 mV/m to 3 mV/m. Both the measured and modeled results show that field strengths for all locations on the Table Mountain NRQZ are below the FCC regulatory limits, given in table 2. Thus, the measured and modeled data show that for Squaw Mountain, a transmitter antenna height of 8.2 m (26.91 ft) does not violate the Table Mountain NRQZ. Predicted field strengths for the actual proposed antenna heights are discussed in the next section.

There are a few situations where the measured and modeled results do not agree very well. This occurs in deep shadow regions. The reason why the ITM fails to correctly predict the field in deep shadow regions is explained as follows. The ITM (or any irregular terrain model for that matter) is considered a quasi-two-dimensional model. This means that irregular terrain models use only the terrain profile for the bearing between the transmitter and receiver. Terrain features and objects that would scatter and/or reflect radio waves that are not on the bearing are not used in the calculation of the field strengths. It is possible that in a deeply shadowed location, the majority of the energy reaching the receiver is from scattering and reflections from objects off of the bearing direction (i.e., mountains, hills, buildings, cars, etc.). In such a deep fade region, the ITM field strength calculations are based only on a diffracted path. Thus, accounting for only the diffracted path and neglecting the other paths results in errors in field strength predictions.

This point is illustrated in figures 63 and 64. These figures show the predicted field strengths for a transmitter location on Squaw Mountain for the McCaslin route and the Boulder-to-Golden route. By comparing these figures to the experimental results presented in figures 36 and 35, respectively, it is seen that for the moderate shadow regions the measured and modeled E-field strengths are similar. For the deep shadow region the two results differ. The modeled results predict lower field strengths than those from the measured data.

For the McCaslin route, strong signal strengths are observed in the middle part of the route, and as the route turns back towards the Flatirons, deep shadowing regions are observed. For the Boulder-to-Golden route, strong signal strengths are observed on Indiana Avenue. However, once the route turns back to Highway 93, deep shadowing is observed in both results. This difference is due to the fact that the ITM does not take into account the full three-dimensional terrain features, and as a result, it underestimates the field strengths.

Once again, this situation only occurs in deep shadow regions. Figures 53, 54, and 62 show that for moderate shadow regions (the Table Mountain NRQZ and the Broadway route), the ITM predictions compare very well to the measured values, illustrating the accuracy of the ITM for moderate shadow regions. In any event, ITM predictions are conservative, since in deep shadow locations the predicted field strengths are less than those that were measured.

## 5. PREDICTED E-FIELD STRENGTHS FOR THE PROPOSED TOWER HEIGHTS

The previous section demonstrated that the ITM model can accurately (except in deep shadow regions, as explained above) predict field strengths for both LOS and non-LOS locations for a given antenna height. Therefore, this model was used with confidence to calculate and predict field strengths for the actual proposed antenna heights for both the Eldorado Mountain and Squaw Mountain sites.

Figures 65 and 66 show contour plots of the E-field strengths for the Boulder–Denver area for a transmitter located at Eldorado Mountain for 533 MHz and 772 MHz, respectively. The results in these figures are for horizontal polarization with a transmitter antenna height of 116 m (379 ft), and a receiver height of 2 m (6.6 ft). Figure 67 shows the E-field strengths at the Table Mountain NRQZ for 533 MHz and 772 MHz. From this figure it is seen that for the Table Mountain NRQZ, the predicted field strengths are about 0.2 V/m. This value, based upon transmission from Eldorado Mountain, exceeds the FCC regulatory limit by about an order of magnitude (or by about a factor of ten in E-field strength). This level of excess would thus jeopardize the research at the Table Mountain NRQZ.

Figure 68 shows the E-field strengths at the DOC Laboratories for 533 MHz and 772 MHz. From this figure it is seen that for the DOC Laboratories, the predicted field strengths approach 0.5 V/m to 1 V/m at various locations. These field strengths are high enough to affect some of the sensitive measurements performed on a routine basis at the DOC Laboratories, see Section 8.

The Squaw Mountain site is analyzed next. Figures 69 and 70 show contour plots of the E-field strengths for the Boulder–Denver area for a transmitter located at Squaw Mountain for 533 MHz and 772 MHz, respectively. The results in these figures are for horizontal polarizations with a transmitter antenna height of 60.96 m (200 ft), and a receiver height of 2 m (6.56 ft). Figure 71 shows the field strengths at the Table